616 TRAFFIC CONTROL

616.01 PERMANENT TYPE WOODEN BARRICADE

(A) DESCRIPTION. This work shall consist of the construction of permanent type wooden barricades at the locations as indicated on the contract plans and/or as directed by the Engineer, and shall be Type III in accordance with the "Manual on Uniform Traffic Control Devices for Streets and Highways" (MUTCD), latest edition.

(B) MATERIALS.

Posts and rails - 821.14(A)
Red and white paints shall be reflectorized.

All assembly hardware shall be hot-dipped galvanized steel meeting the requirements of 811.07. The bolts shall be 1/2 inch in diameter steel carriage bolts equipped with a hexagonal nut. The washer shall be 14-gauge steel, 1-1/2 inch in diameter with 3/4 inch hole.

(C) CONSTRUCTION REQUIREMENTS. Excavation for posts shall be roughly circular and shall be of sufficient diameter to permit thorough tamping of the backfill. Backfill in all cases shall be made with approved embankment materials and shall be thoroughly compacted by tamping to obtain as rigid an installation as possible.

After the alignment of the rails is approved by the Engineer, the nuts shall be tightened and the projecting threads of the bolts shall be burred to prevent removal.

After erection, the rails and posts shall be given 2 coats of paint. The posts shall be painted yellow and the rails shall be painted with alternate diagonal 6 inch stripes of red and white.

All painting shall be done as outlined in 707 using reflective coatings.

(D) MEASURE AND PAYMENT. The unit of measure for Permanent Type Wooden Barricade will be the linear foot. The actual number of linear feet installed, measured along the face of the top rail will be paid for at the contract unit price per linear foot, which payment will include excavation, erection, backfilling, painting, and all labor, materials, tools, equipment and incidentals necessary to complete the work.

616.02 CONSTRUCTION LANE CLOSING

(A) DESCRIPTION. Work consists of executing the provisions of the Special Provision for Maintenance of Highway Traffic as illustrated by the approved Traffic Control Plan (TCP). The work includes preparation of the TCP, as specified in 104.02(B), in accordance with Part VI of the Manual on Uniform Traffic Control Devices (MUTCD) and these specifications; providing a full time Traffic Safety Officer; providing all additional equipment and personnel, including flaggers when required by the Contract documents, as necessary to control traffic as specified or as directed by the Engineer.

(B) TRAFFIC PERSONNEL. The Contractor shall provide all necessary personnel for traffic control. Personnel shall be employed in accordance with requirements of Part VI of the MUTCD and these

specifications. In addition, the following personnel shall be required:

(1) TRAFFIC SAFETY OFFICER. The Contractor shall provide a competent traffic safety officer. The traffic safety officer shall be thoroughly experienced in and qualified for maintenance of traffic safety control work. Prior to commencing work requiring traffic control management, the Contractor shall certify in writing that the proposed Traffic Control Officer, and any designated substitute, has been certified by the American Traffic Safety Services Association (ATSSA). The Contractor shall submit a certificate verifying successful completion of the ATSSA course and a summary of the Traffic Safety Officer's field experience in the operation of work zone traffic control.

Training provided by another agency or firm may be approved by DCDPW. The Department will approve training provided by another agency or firm provided that the following minimum requirements are met:

- Successful completion of a comparable work zone traffic control course including evidence of passing a written examination on the material presented in the course.

- A minimum of one year of documented field experience in work zone traffic control.

The traffic safety officer or his approved substitute, in case of forced absence, is expected to perform his duties on a regular basis and make sure that all traffic maintenance operations are running smoothly at all times by conducting regular inspections along the length of the project, particularly during peak hours.

The traffic safety officer's prime duty shall be the responsibility for the Contractor's maintenance of traffic operations. Duties shall include, but not be limited to, the following:

(a) Understand the requirements of the MUTCD and the contract provisions.

(b) Be responsible for assuring compliance of the Contractor's maintenance and protection of traffic relative to the requirements of the contract provisions.

(c) Be responsible for assuring that all deficiencies are corrected.

(d) Be responsible for coordinating maintenance of traffic operations with the Engineer.

(e) Be responsible for assuring that all traffic control devices are placed in their proper location and that damaged traffic control devices are promptly replaced.

(f) Supervise the installation and removal of all temporary traffic control devices and pavement markings.

(g) Be responsible for daily inspection of the work zone traffic control devices. Inspection results shall be recorded in a Traffic Control Device Inspection Log. The Contractor may use either the sample form included in the Appendix to the contract Specifications or a similar company form.

The Engineer or his designated representative shall inspect the traffic maintenance devices and marking layout on a routine basis. Any deficiencies that are noted will be brought to the Contractor's attention for correction. The Engineer's inspection will not relieve the contractor of any responsibility for maintaining traffic control items in proper position and condition based on his own inspection.

If any deficiency is not corrected within 24 hours from the documented notice given to the contractor, a payment deduction will be made from the Contractor's next progress estimate. The deduction will be equal to the daily prorated share of the total price bid for "Construction Lane Closing" or $500.00 per day, whichever is greater, for each day or portion thereof that the deficiency exists, and will continue until the deficiency is satisfactorily corrected and accepted by the Engineer. The amount of money deducted will be a permanent deduction from the Contract amount and will not be recoverable.

(2) FLAGGERS. When specified in the Contract documents or when directed, the Contractor shall provide all necessary flaggers required to properly maintain traffic through the work zone. Flaggers shall meet requirements of Section 6E-2 of the MUTCD and shall be employed in accordance with applicable requirements of Sections 6E-5 and 6E-6 of the MUTCD.

(C) MEASURE AND PAYMENT. No direct measure will be made. The unit of measure will be the job. Payment for Construction Lane Closing will be made at the contract lump sum price, which payment will include preparation and submission of the TCP and providing a Traffic Safety Officer, flaggers and all additional personnel and equipment necessary to efficiently and safely execute the Traffic Control Plan as approved and maintain the roadway surface for thru traffic.

616.03 REMOVAL OF LANE MARKINGS

(A) CONSTRUCTION REQUIREMENTS. Existing pavement markings in some areas will conflict with new lane widths and shall be removed.

Markings may be ground off or removed by any method acceptable to the Engineer which effects complete removal. The work, however, shall be carefully performed so as not to damage or scar the asphalt surface. Burning shall not be permitted. Damaged asphalt surfaces shall be repaired at no additional cost to the District. All grind marks on AC pavement shall be painted with emulsified asphalt to reduce the visibility of the line removed.

During any detouring or lane changes, inappropriate pavement marking shall be properly and promptly obliterated prior to placement of detour or new lanes in operation. Marking removal shall be accomplished regardless of time of day or climatic conditions.

Improper obliterations such as incomplete paint removal, painting over lines with black paint, or any procedure which leaves scars and unwarranted delays shall be prohibited.

Requirements of Part VI of the MUTCD are applicable.

(B) MEASURE AND PAYMENT. The unit of measure for Removal of Lane Markings will be the square foot, with measurement made on actual width of marking multiplied by length removed.

Payment will be made at the contract unit price per square foot, which payment will include removal operations, any asphalt material and rolling required to return the pavement surface to an acceptable condition, removal of all surplus materials and all labor, tools, materials, equipment and incidentals necessary to complete the work.

616.04 TEMPORARY CONSTRUCTION SIGN SUPPORTS

(A) DESCRIPTION. Work consists of furnishing, assembling and maintaining Temporary Construction Sign Supports required for construction warning and detour signs in or adjacent to the work area, as specified in the TCP. Work also includes removal of the supports from the job site when no longer required.

Sign supports may be either fixed or portable. Fixed supports requiring one or more posts shall be considered as one temporary support. Replacement posts, due to damage or relocation, shall not be counted. For fixed supports, work also includes excavation and/or augering, including backfilling and compaction, to firmly set the posts and eventual removal and restoration of the site. Posts shall be set plumb.

Portable supports shall include necessary stabilizers (sand bags).

If barricades are approved for use as sign supports, payment will be made at the contract unit price for the type of barricade used.

All construction sign supports shall be in accordance with Part VI of the MUTCD.

(B) MEASURE AND PAYMENT. The unit of measure for Temporary Construction Sign Supports will be each. The total shall be the maximum number required and used for any one phase of construction.

Payment will be made at the contract price per each. This payment will include furnishing (including sand bags), assembling, maintaining (including replacement of damaged parts of units at no additional cost to the District) and removing all Temporary Construction Sign Supports required.

616.05 PORTABLE TRAFFIC SIGNAL BASES

(A) DESCRIPTION. Work consists of furnishing, maintaining and moving portable concrete traffic signal bases, where required, for traffic signals within the limits of work. A 4-foot by 4-foot by 1-foot deep concrete type base shall be provided, unless otherwise approved by the Engineer. Work also includes removal of the bases from the job site when no longer required.

(B) MEASURE AND PAYMENT. The unit of measure for Portable Traffic Signal Bases will be each. The total number of bases shall be the maximum number required and used in any one phase of construction.

Payment will be made at the contract bid price per each. This payment shall include furnishing, maintaining (at no additional cost to the District) and removal of all required Portable Traffic Signal Bases on the project.

616.06 CONSTRUCTION WARNING AND DETOUR SIGNS

(A) DESCRIPTION. Work consists of furnishing, assembling and maintaining construction warning and detour signs as specified in the Traffic Control Plan (TCP) or as directed by the Engineer. Also included is removal of the signs from the job site when no longer required.

All construction warning and detour signs shall be in accordance with the requirements of Part VI of the MUTCD.

When not in use, signs shall either be removed or completely covered. Covers shall be of an opaque

material; burlap or black plastic shall not be used.

Where signs are mounted on light standards, traffic signal supports, etc., work includes furnishing mounting bands or clamps, including all installation hardware.

(B) MEASURE AND PAYMENT. The unit of measure for Construction Warning and Detour Signs will be the square foot. The total measure shall be the maximum number of square feet required for the project.

Payment for Construction Warning and Detour Signs will be made at the contract unit price per square foot, which payment will include furnishing, assembling, maintaining (including replacement of damaged signs at no additional cost to the District) and removing all required Construction Warning Signs on the project.

616.07 REFLECTORIZED TRAFFIC CONES

(A) DESCRIPTION. Work consists of furnishing and maintaining traffic cones at the job site. Traffic cones shall be used for short duration traffic channelizations such as installing signs, establishing lane closure, removing or installing pavement markings and installing raised markers. Work also includes removal of the cones from the job site when no longer required.

The reflectorized band shall be of high intensity reflective material. Cones shall be a minimum of 28 inches in height.

(B) APPLICATION. Cones shall be used in accordance with requirements of Part VI of the MUTCD.

(C) MEASURE AND PAYMENT. The unit of measure for Reflectorized Traffic Cones will be each. The total shall be the maximum number required and furnished for any one phase of construction.

Payment will be made at the contract unit price per each, which payment will include furnishing, maintaining (including replacing damaged units at no additional cost to the District) and removing all required traffic cones.

616.08 STEADY BURNING AMBER LIGHTS, TYPE "C", AND FLASHING AMBER LIGHTS, TYPE "B'

(A) DESCRIPTION. Work consists of furnishing, placing, and maintaining warning lights on the Portable PCC Barriers and when required by the Engineer. Warning lights shall be in conformance with Part VI of the MUTCD. Work also includes removal of the lights from the job site when no longer required.

Lights shall include hardware which shall facilitate attachment to barriers or traffic drums which may be used to delineate traffic lanes.

Steady burning lights shall be used only if specified on the TCP or at the direction of the Engineer. Flashing lights shall be mounted on advance warning signs.

(B) MEASURE AND PAYMENT. The unit of measure for Steady Burning Amber Lights, Type C

and Flashing Amber Lights, Type B, shall be each. The total measure will be the maximum number required for any one phase of construction.

Payment for these items will be at the contract unit price per each, which payment will include furnishing, placing, maintaining (including replacing damaged units at no additional cost to the District) and removal of all warning lights as specified.

616.09 ELECTRONICALLY ILLUMINATED TRAFFIC DEVICES (SEQUENTIAL ARROW BOARDS)

(A) DESCRIPTION. Work consists of furnishing, maintaining and relocating as required Sequential Arrow Boards required to channel traffic away from or through work areas as shown on the TCP or as directed by the Engineer. Work also includes removal of the arrow boards from the job site when no longer required.

(B) OPERATIONAL REQUIREMENTS. The Electronically illuminated traffic control device shall be a sequential arrow type and shall be a minimum of 36 inches high and 72 inches long, and shall be finished with flat black enamel. There shall be a minimum of 15 No. 44121. PART 46, 12 volt amber lamps. The lamp configuration shall have an arrow head pointing in each lateral direction at each end of the panel, with a minimum of 5 lamps forming the arrow bar (arrow tail). Each lamp shall be provided with a visor and the lamps, when illuminated, shall be visible on a clear, cloudless day, for a minimum distance of 3/4 mile. Chevron type devices shall not be used.

The lamps shall be activated by a switch on a control panel and shall be controlled by electronic circuitry to provide 4 selectable modes of operation as follows:

Pass Left - Sequencing of lighted arrowhead to the left.

Pass Right - Sequencing of lighted arrowhead to the right.

Pass Right and Left - Lighted arrowheads flashing right and left simultaneously.

Travel - The two outside top and bottom lamps on the panel flash on and off simultaneously.

The electronic circuitry shall provide 25 and 40 completed operating cycles of the sign per minute in each of the modes specified above.

A switch controlled variable dimming device shall be provided on the control panel which will reduce the voltage on the lamps a maximum of fifty (50) percent for nighttime use.

Electrical energy for operating the sequential arrow board shall be obtained from a noiseless device or source such as a solar-powered or battery-powered source. Alternative noiseless power sources may be used upon prior approval of the Engineer. The source used shall be capable of operating the sequential arrow board in the manner heretofore specified. The use of gasoline-powered or diesel-powered motors or generators as energy sources for this work will not be permitted.

Signs mounted on the cab of a truck shall be mounted to provide a minimum of 7 feet between the bottom of the sign and the roadway.

Signs mounted on a trailer, or on other than the cab of a truck, shall be mounted to provide a minimum of 8 feet between the bottom of the sign and the roadway.

If advance written approval is given by the Engineer, a similar alternate flashing arrow sign configuration may be used.

If sequential arrow signs, or the vehicle on which said signs are mounted, are damaged from any cause during the progress of the work, the Contractor shall immediately repair or replace said signs to their original condition and location. Payment for this work will be in accordance with 616.23.

(C) MEASURE AND PAYMENT. The unit of measure for Sequential Arrow Boards will be each. The total will be the maximum number required and used for any one phase of construction.

Payment will be made at the contract unit price per each, which payment will include furnishing, relocating as required, maintaining and removing all units as specified.

616.10 CONSTRUCTION SIGN WARNING FLAGS

(A) DESCRIPTION. Work shall consist of furnishing, placing and maintaining a pair of 16" x 16" orange flags with mounting staffs on certain construction signs at the job site as shown on the Contract Drawings. Traffic flags shall be in accordance with Part VI of the MUTCD, except they shall be orange in color. Work also includes removal of the flags from the job site when no longer required.

(B) MEASURE. The unit of measure for CONSTRUCTION SIGN WARNING FLAGS will be per each pair of flags. The total will be based upon the maximum number of pairs required and installed at any given time.

(C) PAYMENT. Payment for CONSTRUCTION SIGN WARNING FLAGS will be made at the contract unit price per each pair of flags, which payment will include furnishing, installing, maintaining and removing all required flags.

616.11 TYPE III PVC BARRICADES

(A) DESCRIPTION. Work consists of furnishing and maintaining Type III PVC Barricade (Polyvinyl-chloride 3 inch pipe) at the job site. Barricades shall be in accordance with Part VI of the MUTCD except that the area of orange and white shall be of high reflective Type III material with a smooth surface. When specified in the Contract documents, barricades shall be equipped with 2 Type "B" lights. Work also includes removal of the barricades from the job site when no longer required.

(B) APPLICATION. Type III PVC barricades shall be used in accordance with Section 6F-5f(2) of the MUTCD.

(C) MEASURE AND PAYMENT. The unit of measure for Type III PVC Barricade will be each. The total number will be the maximum number required and used for any one phase of construction.

Payment will be made at the contract unit price per each, which payment will include furnishing (including sand bags), assembling, maintaining (at no additional cost to the District) and removal of the barricades required.

Measure and payment for Type "B" lights affixed to Type III barricades will be made in accordance with 616.08(B).

616.12 TYPE II BARRICADES

(A) DESCRIPTION. Work consists of furnishing, maintaining, and relocating as required during the duration of the project, Type II Barricades. Barricades shall be in accordance with Part VI of the MUTCD except that the area of orange and white shall be of high reflective Type III material with a smooth surface. The barricades shall be placed in areas delineated in the contract documents and/or as directed. Each barricade shall be weighted down with two 5 pound bags of sand placed on the lowest rung. When specified in the Contract documents, barricades shall be equipped with Type "B" or Type "C" lights, meeting requirements of 616.08. Work also includes removal of the barricades from the job site when no longer required.

(B) APPLICATION. Type II barricades shall be used in accordance with Section 6F-5f(2) of the MUTCD.

(C) MEASURE AND PAYMENT. The unit of measure for TYPE II BARRICADE will be each. The total number will be the maximum number used for any one phase of construction.

Payment for TYPE II BARRICADE will be made at the contract unit price per each, which payment will include furnishing, including sand bags, maintaining and relocating as required, and removal of the Type II barricades when no longer required for the project.

Measure and payment for Type "B" or Type "C" lights affixed to Type II barricades will be made in accordance with 616.08(B).

616.13 TRAFFIC DRUMS

(A) DESCRIPTION. Work consists of furnishing, maintaining and relocating as required during the duration of the project Traffic Drums. Drums shall be in accordance with Part VI of the MUTCD and shall be made of high impact low density polyethylene or of other approved material and have a smooth sealed outer surface. Drums shall be largely cylindrical in shape with a sufficient number of flat surfaces to prevent rolling. The reflective surface shall be made of Type III high intensity reflective material. When specified in the Contract documents, drums shall be equipped with a Type "B" or Type "C" light. Work also includes removal of the drum from the job site when no longer required.

(B) APPLICATION. Traffic drums shall be used in accordance with Section 6F-5e(2) of the MUTCD.

(C) MEASURE AND PAYMENT. The unit of measure for TRAFFIC DRUMS will be each. The total number will be the maximum number required and used for any one phase of construction.

Payment will be made at the contract unit price per each, which payment will include furnishing, maintaining and relocating as required, and removal of the traffic drum from the project site when no longer required.

Measure and payment for Type "B" or Type "C" lights affixed to drums will be made in accordance with 616.08(B).

616.14 REFLECTIVE MARKERS

(A) DESCRIPTION. Work consists of furnishing and installing Raised Reflective Pavement Markers of the snowplowing type as lane and edgeline delineation where shown in the contract documents. This item shall also consist of furnishing and installing Reflective Barrier Markers and Reflective Guardrail Markers.

(B) MATERIAL. Casting, Reflector, Primer and Adhesive - 821.15.

(C) CONSTRUCTION REQUIREMENTS.

(1) RAISED REFLECTIVE PAVEMENT MARKERS. Markers shall be installed in the locations indicated in the contract documents and/or as directed by the Engineer. The casting shall fit into a groove cut in the road surface. The reflector shall be approximately even with the road surface.

Markers along lane lines shall be installed centered between skip lines. Markers along edge lines shall be installed along the travel side of the edge line. Where double white markers are indicated, the markers shall be installed to the right and left of the line and 2 inches between line and marker.

On ramp roadways and sharp radius horizontal curves, care is to be exercised so that the markers are installed at right angles to the direction of headlight beams. The color of the pavement markers shall be white along the right side of all traveled roadways and along the lane lines, and yellow along the left side of all traveled roadways, unless otherwise indicated or directed.

A self-propelled concrete cutting machine shall be used for making the grooves in the pavement to fit the casting. The machine shall utilize either a local or tank supplied water source for cooling the blades, to act as a lubricant and to clean the saw cuts. The saw cuts shall be flushed clean by means of a water stream, then cleared of water and dried by means of an air stream. The blown air from the compressor shall be free of oil and water. The saw cuts shall be cleaned immediately after the cutting operation.

After the saw cuts have been cleaned and dried, the cuts shall be filled with an approved epoxy compound. The epoxy shall be kept warm until it is poured into the saw cuts. After the marker casting is pressed into the saw cuts, excess adhesive around the edge of the marker, on the pavement, and on the exposed surfaces of the markers shall be immediately removed.

Soft rags moistened with mineral spirits, conforming to Federal Specification TT-T-291, or kerosene may be used, if necessary, to remove adhesive from exposed faces of pavement markers. No other solvent shall be used. The marker shall be protected against impact until the adhesive has hardened to the point where the marker will not be dislodged by traffic, but in no case less than one hour. Any marker dislodged before completion of the contract shall be replaced by the Contractor at no cost to the District.

The markers shall be placed so that in all cases the plane of the reflective surface shall be at right angles to the direction of traffic. No pavement marker shall be placed over longitudinal or transverse pavement joints.

(2) REFLECTIVE BARRIER MARKERS. The marker shall be mounted 24 inches above the roadway surface, with the reflecting surface normal to the direction of traffic, and the longer axis vertical.

The marker shall be attached to the barrier with a butyl pad, epoxy or solvent cement. If a primer is required for preparing the barrier surface prior to attaching the marker, the primer shall be that recommended by the manufacturer. A force of not more than 50 pounds applied to the marker for not longer than 6 seconds shall be sufficient to securely attach the marker to the concrete surface.

(3) REFLECTIVE GUIDERAIL MARKERS. The marker shall be installed in the guiderail so as to be completely enclosed by, and flush with, the guiderail. The marker shall be attached to the guiderail by means of butyl pads, epoxy or solvent cement. The reflective surface of the marker shall be normal to the direction of traffic, with the longer axis vertical.

(D) MEASURE AND PAYMENT. The unit of measure for Raised Reflective Pavement Markers will be each. No measure will be taken for either Reflective Barrier Markers or Reflective Guiderail Markers.

Payment for Raised Reflective Pavement Markers will be made at the contract unit price per each, which payment will include furnishing complete markers and their installation and all other materials, labor, tools, and equipment necessary to complete the work.

No payment will be made for either Reflective Barrier Markers or Reflective Guiderail Markers. The cost of furnishing and installing the markers will be included in the contract price for the respective barrier or guiderail pay item.

616.15 THERMOPLASTIC PAVEMENT MARKINGS

(A) DESCRIPTION. Work consists of furnishing and applying stripes, letters, arrows, diamonds and other markings on a finished roadway pavement as detailed in the contract documents and specified by the Engineer. Details of pavement letters, arrows and diamonds shall meet the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) for 8 foot letters, elongated arrows and diamonds. The Contractor shall furnish all supervision, labor, supplies, and equipment necessary for the proper conduct and completion of the work.

(B) MATERIALS. Materials shall meet the requirement of 820.02.

(C) CONSTRUCTION REQUIREMENTS. The Contractor shall prepare the roadway surface by cleaning, buffing and then any treatment as may be necessary. The compound shall be applied as prescribed by the manufacturer. Pans and aprons to regulate the width of lines shall not be permitted. The equipment, including the extrusion die, shall be such as to maintain the compound at its proper extrusion, temperature and density, resulting in a stripe of specified width and not more than 3/16 inch nor less than 1/8 inch thick. The compound shall be extruded at a temperature of 400 to 425°F, ambient air temperature shall be 35°F or greater, and the ground temperature shall be 45°F or greater.

The compound shall be set with straight, clean-cut, parallel edges shaped to minimize tire impact.

Reflectorizing shall be accomplished by an immediate follow-through of reflective spheres at the rate of 1 pound per 120 feet of 4 inch stripe, or 3 pounds per 120 square feet of stripe. Reflective spheres shall be applied in such quantity and in such a manner that the completed line will register a reading of 55 on the Hunter Night Visibility Meter.

(D) DRYING TIME. Drying time necessary for the stripe to become permanently fixed and to set so that normal traffic will not create distortion shall not appreciably exceed the straight line curve established

by the values of 2 minutes at 50°F, and 15 minutes at 90°F ambient air temperature and 70 percent relative humidity.

(E) MEASURE AND PAYMENT. The unit of measure of marking stripe will be the linear foot. Measurement for letters, arrows and diamonds will be per each.

Payment will be made at the contract unit price per linear foot for each size of marking stripe complete in place and per each for letters, arrows and diamonds. The payment will include conditioning of pavement surfaces, sampling and testing, all extruding and installation operations, including any removal and reinstallation of faulty, or otherwise unacceptable marking stripes, necessary protection of marking stripe, and all labor, tools, materials, equipment and incidentals necessary to complete the work.

616.16 PAINTED LANE MARKINGS

(A) DESCRIPTION. Work consists of furnishing all materials for and painting temporary 4-inch wide white skip lines and/or 4-inch wide yellow edge lines as detailed in the contract documents or as directed by the Engineer. The paint shall be reflectorized by glass beads either pre-mixed by the manufacturer or dropped-on at the same time as the paint is applied.

Where directed by the Engineer, temporary crosswalk lines and stop bars shall be painted with one or more widths as directed.

(B) MATERIALS. Materials shall meet the following requirements:

Paint - 820.04

Beads - 820.05(C)

(C) CONSTRUCTION REQUIREMENTS. The paint shall be applied on a clean and dry surface at the rate recommended by the manufacturer. If no rate is specified the paint shall be applied at the rate of 16.5 gallons per mile of 4-inch continuous stripe to a thickness of 15 mils. Drop-on beads shall be applied at the rate of 6 pounds per gallon, and combined paint and bead at 3 pounds per gallon of paint.

Stripes shall be sharp, clean-cut, and well defined lines within the following tolerances:

(1) The longitudinal accumulative offset within a 40 foot length of lane line shall be not more than plus or minus 1 inch.

(2) The width shall not vary more than plus or minus 1\4 inch.

(D) MEASURE AND PAYMENT. The unit of measure for Painted Lane Markings will be the linear foot. Payment will be made at the contract unit price per linear foot, which payment will include furnishing all materials and all labor, tools, equipment, and incidentals necessary to complete this item of work.

616.17 TAPED LANE MARKINGS

(A) DESCRIPTION. Work consists of furnishing and installing temporary taped 4-inch wide white skip lines and/or taped 4-inch wide yellow edge lines as shown in the Contract documents or as directed by

the Engineer. Work includes repairing damaged lengths and prompt removal and disposal of the taped markings when no longer required. Where possible, taped markings shall be saved for reuse in more than one phase of construction.

Where directed by the Engineer, temporary crosswalk lines and stop bars shall be installed with one or more widths as directed.

(B) MATERIALS. Markings shall be of a pressure-sensitive, non-foilback type, which can be readily taped to the pavement surface, will stay down and can be readily removed without damaging the pavement surface. Approval of the Engineer of the type to be used shall be obtained prior to installation.

(C) CONSTRUCTION REQUIREMENTS. Where required, the surface to which tape temporary pavement markings are to be applied shall be swept clean of all dirt and debris so that proper adhesion of the taped markings to the pavement surface can be achieved.

All temporary marking installations shall be in accordance with Part III and Section 6F-6 of the MUTCD.

(D) MEASURE AND PAYMENT. The unit of measure for TAPED LANE MARKINGS will be the linear foot. Payment will be made at the contract unit price per linear foot, which payment will include furnishing all materials and all labor, tools, equipment and incidentals necessary to complete this item of work. The removal and eventual disposal of the temporary tape is considered incidental to the work in this pay item and will not be measured under 616.03.

616.18 TRUCK MOUNTED ATTENUATOR

(A) DESCRIPTION. Work consists of furnishing, installing, maintaining and repairing a Truck Mounted Attenuator (TMA) on the project site.

(B) TMA REQUIREMENTS. The truck mounted attenuator shall be capable of being mounted on the rear of a dump truck or other vehicle, provided by the Contractor, within the weight range of 5 to 10 tons.

The TMA shall have the capability of being able to decelerate an errant vehicle within the range of 2,000 to 4,500 pounds, reduce the roll ahead movement of the truck, and absorb at least 69% of the impact energy of a 4,500 pound car traveling 60 mph, striking a truck weighing approximately 10,000 pounds, and absorb 80 percent of the impact energy of the same weight vehicle striking a truck weighing 20,000 pounds. The unit shall be equipped with a hydraulic system for tilting to a vertical position on the truck when not in use.

(C) CONSTRUCTION REQUIREMENTS. The truck mounted attenuator shall be kept in operating condition at all times during construction. Should the TMA(s) become damaged from any cause during the progress of the work, the Contractor shall immediately repair or replace the parts as in accordance with 616.23. All other costs related to the maintenance of this unit shall be reflected in the bid price for this item. At the completion of the project, the unit shall remain the property of the Contractor and shall be removed from the project site.

(D) MEASURE AND PAYMENT. The unit of measure for Truck Mounted Attenuator shall be per each unit furnished and installed.

Payment for Truck Mounted Attenuator shall be at the contract unit price per each and shall include furnishing, installing on a suitable vehicle, maintenance, repair and disposal of the unit and all materials, parts, labor, tools and incidentals needed to perform the required work.

616.19 CONSTRUCTION ZONE ATTENUATOR

(A) GENERAL. Work under this item consists of furnishing, installing and maintaining, in accordance with the manufacturer's specifications for the speed (MPH) indicated on the plans, portable Construction Zone GREAT (Thrie beam) attenuators, or approved equivalents, for temporary protection during construction as shown on the approved TCP or as directed by the Engineer. Work also includes relocating the attenuators as work progresses and removal of the attenuators from the project site when no longer required for protection. A hazard marker shall be installed on the nose of the unit.

As part of this work, the Contractor shall have available for replacement sufficient parts, as recommended by the manufacturer, to repair the unit if needed.

(B) MATERIALS. All materials for this work shall be approved and shall meet the following requirements:

ENERGY ABSORBING CARTRIDGES - Cartridges shall consist of closed polyurethane containers, completely filled with a matrix of hexagonal shaped cardboard honeycomb filled with polyurethane foam, so that upon impact, compression occurs one row at a time, and so packaged to contain debris and to protect against weathering.

DIAPHRAGMS - Diaphragms shall be boxes 3 inches deep by 24 inches high by 30 inches wide, formed from 14 gauge galvanized steel and containing the energy absorbing cartridges. Two 2-1/2 inch diameter pipes extending from the bottom of each diaphragm shall serve as legs. Stabilizing chains, 3/8" galvanized, shall connect each leg to the base plate assembly in such a way as to limit lateral movement during side impacts yet allow the diaphragm to move backward freely when head-on impact occurs.

THRIE BEAM PANELS - Panels shall be 10 gauge galvanized steel thrie beam guiderail sections bolted at their front ends to each side of the diaphragms. The back ends shall overlap the side panels of the following bay and shall be attached in such a way as to telescope freely when the attentuator is impacted head-on.

NOSE WRAP - The nose wrap shall be made of cross linked, high density polyethylene molded to match the thrie beam. It shall offer substantial yielding yet possess strong ability to recover to its original molded shape.

BACKUP STRUCTURE - All metal shall be AASHTO M 183 unless otherwise specified and it shall be hot dipped galvanized per AASHTO M 111.

HAZARD MARKER - A hazard marker, meeting the requirements of Section 3C, Type 3, of the MUTCD, shall be attached to the nose of each attenuator. The hazard marker shall face oncoming traffic.

(C) APPLICATIONS - Construction Zone GREAT attenuators shall be required at approach ends of portable PCC safety barriers, where protection by means of sand filled modules is not feasible, and also

at other locations, within the project area, which the Engineer deems to be hazardous to vehicular traffic.

(D) CONSTRUCTION REQUIREMENTS - Installation of the attenuators shall be accomplished by the Contractor with experienced workers in accordance with the recommendations of the manufacturer. In particular, the Contractor shall be aware of and follow requirements concerning the secure attachment of the unit to the roadway in a manner as recommended by the Engineer.

The Contractor shall be responsible for the repair and replacement of all attenuators within the limits of the project (construction area) for the duration of the contract. Payment for this work will be made in accordance with 616.23.

(E) SHOP DRAWINGS - Before installation, shop drawing shall be submitted in accordance with the S.P. for SHOP AND WORKING DRAWINGS.

(F) MEASURE AND PAYMENT - The unit of measure for CONSTRUCTION ZONE ATTENUATOR for the size specified will be each. The number will be the maximum number required for any one phase of construction.

Payment for CONSTRUCTION ZONE ATTENUATOR will be made at the contract until price per each, which payment will include furnishing, placing, relocating and removing when longer required the attenuator, as measured above. The payment shall also include labor for replacing parts and all labor, materials, including appurtenances and hazard markers, tools, equipment and incidentals needed to complete the work as specified herein.

616.20 SAND-FILLED IMPACT ATTENUATOR MODULES

(A) GENERAL. Work consists of furnishing, installing, relocating as required, maintaining and removing temporary attenuators of the frangible sand-filled inertial module type, to be placed at each traffic-facing end of the portable concrete barriers and at other locations as shown on the Traffic Control Plan and /or as directed.

Also included as part of this work shall be furnishing and installing hazard markers, meeting requirements below. One (1) hazard marker shall be attached to the lead module of each installation. The marker shall face oncoming traffic.

(B) MATERIALS. Each module shall consist of cylinder, core, lid and sand.

(1) Cylinders, lids and cores shall be of an approved type. Cylinders shall be yellow in color.

(2) Sand shall conform to 803.01, dried to contain not more than one percent (1%) moisture by weight.

(3) Hazard Markers shall meet requirements of Section 3C, Type 3, of the MUTCD.

(C) FIELD INSTALLATION. Assembly and installation of inertial modules shall be in accordance with the recommendations of the manufacturer for the speed (MPH) indicated in the plans.

(C) MEASURE AND PAYMENT. Unit of measure will be each. The total will be the maximum number in use at any one time.

No measure or payment will be made for hazard markers. Furnishing and installing hazard markers will be considered as incidental part of the work under this item.

616.21 PORTABLE VARIABLE MESSAGE SIGNS

(A) GENERAL - Work under this item consists of furnishing, locating, operating and maintaining self-contained, trailer-mounted, variable message signs where shown on the plans or as directed by the Engineer. The varible message signs are to be used for motorist advisory information.

(B) MECHANICAL AND OPERATIONAL REQUIREMENTS.

(1) The sign system shall consist of a three line matrix panel assembly, sign mounted controller, power source, enclosures and structural support system. The message shall be visible and legible from a distance of 900 feet from any point of the roadway during 24 hour operations.

(2) The sign system shall be capable of operating under all enviromental conditions expected to be encountered in the District of Columbia. The messages shall be visible and legible under all roadway geometric conditions normally encountered in the District of Columbia. Headlight glare shall be taken into consideration and the sign face shall be contructed of a material suited to the enviromental requirements as stated above.

(3) Messages shall be capable of being cycled so that two message cycles are displayed to the driver while approaching at 55 mph from 900 feet.

(4) The sign unit shall be capable of operating on a continuous basis for not less than five days. The sign unit shall be capable of raising and lowering the message panel electrically and manually in the vertical axis and rotating it 30 degrees in a horizontal axis. While in the raised position the bottom of the sign panel shall be a minimum of eight feet above the pavement surface. The sign panel shall be capable of rotating 360 degrees and be stopped in any position.

(5) The sign panel shall be three lines in height, and shall contain at least eight modular and interchangeable matrix assemblies per line. Each modular matrix assembly shall be capable of displaying a character.

(6) The controller shall be easily located and accessible to allow the entry of all sign and message functions from a control cabinet on the trailer mounted unit.

(7) A keyboard shall be incorporated into the controller to allow the user to generate and store a minimum of 20 preprogrammed messages and any message entered by the operator. The controller shall have the capability of retrieving all messages stored in the temporary memory for as long as the sign panel is in operation.

(8) A START/STOP switch shall be provided on the controller to activate the power supply and sign panel. An entry code shall be required to gain entry to the controller to access the memory and display messages on the exterior sign panel.

(9) The sign unit shall be capable of operating from two power sources. Each power source shall be a noiseless type as specified in 616.09(B).

(10) The trailer and sign support system shall be painted safety orange.

(C) MEASURE AND PAYMENT - The unit of measure for PORTABLE VARIABLE MESSAGE SIGN will be per each sign delivered to the job site and accepted by the Engineer. The total will be the maximum number of signs required and used for any one phase of construction.

Payment for Portable Variable Message Sign will be at the contract unit price per each sign used . The unit price bid shall include all labor, tools, materials and incidentals necessary to provide variable message signs as specified. The contractor shall operate the variable message signs including setup, programming, placing, providing all messages specified in the contract documents or requested by the Engineer, maintenance and fueling, for which payment shall be reflected in the bid item for this work.

616.22 PORTABLE DISC CHANGEABLE MESSAGE SIGNS

(A) GENERAL. The Portable Disc Changeable Message sign shall be a self-contained unit which includes a matrix message board, solid state controls, noiseless power source, and trailer.

The matrix message board shall consist of three (3) lines of continuous matrix with fifty (50) columns by seven (7) rows.

The Portable Disc Changeable Message Sign Controller shall provide for the selection and display for four (4) test diagnostic messages and 200 prestored messages, and have legibility of up to 1,000 feet in bright direct sunlight. For nighttime operation, a method of dimming shall be provided. The controller shall provide the capability of alternately displaying or sequentially flashing up to sixteen (16) messages, the variation of message on/off time, and automatic photocell operation of the internal illumination. The controller shall be operated from a portable keyboard with display which shall be removable after displaying a message. The controller shall be enclosed in a lockable cabinet to prevent unauthorized manipulation.

The trailer for the Portable Disc Changeable Message sign shall be equipped with heavy duty axles and hitches, safety chains, 12 volt running and four-ply rated tires. The trailer shall be designed to support the message board and generator in both a fixed or travel position. The sign message board support shall provide for positioning the message board up to a height of seven (7) feet, measured from ground level to the bottom of the message board, and for rotation of the message board 360 degrees about the vertical axis. The trailer shall provide for an adequate vandal-proof and weatherproof housing for both the controller and generator power supply.

The noiseless power source shall be capable of supplying continuous power for operation of the disc message board.

All exterior surfaces of the trailer, generator cage, message board and controller cabinet shall be cleaned, primed and finished with two (2) coats of Federal Yellow except for the disc message board front and interior, which shall be flat black.

(B) DISC MODULE DESIGN. The disc module shall consist of 35 disc elements arranged in a 7 high X 5 width matrix. Each module shall be wired in column and row, eliminating the need for individual power and control lines to each element.

Each module shall have a column connector with five (5) column conductors and a row connector

with seven (7) set and seven (7) reset conductors. Row connectors on each module in a horizontal line of display shall be connected in parallel to a row control board and column connectors on each module forming a vertical column shall be connected in parallel to a column board.

(C) CHARACTERISTICS. The portable Disc Changeable Message Sign shall be designed to operate in the ambient temperature range of -40 degrees to +165 degrees F. The unit shall not be affected by mobile radio transmissions or other RF signals.

The message displayed on the sign disc message board shall have a viewing distance of 1,000 feet.

All messages shall be flashed or sequenced so that at least three (3) messages are displayed to a motorist while approaching the sign at 55 MPH. A standard flash rate of two (2) seconds "ON" and one (1) second "OFF" shall be used to both flash and sequence messages. This rate shall be adjustable in the sign controller from one (1) to ten (10) seconds.

In the event the sign message requires internal illumination the sign shall be equipped with a photocell for nighttime operation.

All exterior surfaces of the Portable Disc Changeable Message Sign shall be painted standard Federal Yellow except for the background of both interior and front face of the message board, which shall be painted flat black.

The entire engine generator assembly shall be shock-mounted to the sign trailer frame to reduce vibration. An accessory exhaust system shall be provided to minimize exhaust noise.

A start/stop switch shall be provided on the engine generator assembly to operate the generator power supply.

(D) SIGN PANEL ASSEMBLY. The sign panel assembly shall be constructed of aluminum and shall not be more than 12' wide and 7' high by 12" deep. The sign panel frame shall be an extruded aluminum channel designed to allow hinged front doors to be inset in the sign panel for maximum environmental protection. All angles shall be mitered and welded. All seams shall be continuously welded.

The sign panel assembly shall contain a disc bank made up of three (3) lines, each line consisting of fifty (50) columns having seven (7) disc modules per column. Each line shall be composed of ten (10) identical disc matrix modules consisting of 35 disc elements configured in a 5 X 7 matrix. All disc modules shall be identical and can be interchanged to any position in the sign board for reduction of maintenance spares. All logic power supplies shall be equipped with an indicating LED for ease of maintenance in determining malfunctions.

The sign board shall be raised and lowered by means of an electrical power driven lifting mechanism, operated from the engine control compartment, and shall be capable of elevating the sign board to a full operational height of seven (7) feet from the ground to the ground to the bottom of the sign board in a maximum time of one (1) minute. The sign board lifting mechanism shall be operated directly from the engine starting battery, enabling failure.

(E) POWER SUPPLY. The power supply unit for operating the entire sign system shall be a noiseless type, as specified in 616.09(B).

(F) STRUCTURAL SUPPORT SYSTEM. The sign and power supply unit shall be mounted on a steel trailer design and built for a 5,000 pound capacity. The trailer shall be constructed of 3" X 3" steel tube in deep section structural shapes and shall be 6' wide by 15' long. The trailer shall utilize a heavy duty axle with hydraulic brakes, load range D classification tires and 5,000 lb. capacity leaf springs.

The trailer shall have a 6,000 lb. capacity hydraulic brake actuator hitch with a 2" ball, hydraulic breakaway, safety chains and a demountable 2,000 lb. top winder trailed tongue jack. The trailer shall be equipped with adjustable outrigger leveling pads, one on each of the four frame corners.

(G) PORTABLE DISC CHANGEABLE MESSAGE SIGN GENERAL SPECIFICATIONS:

OPERATING CURRENT (DISC)	-	1.0 amp maximum @ 200 microsecond pulse per disc element
POWER REQUIREMENTS (SIGN)	-	115 VAC, 15 amp supply circuit for any size sign
TEMPERATURE REQUIREMENTS	-	-40°F to +165°F
RELATIVE HUMIDITY	-	95% at any temperature in the above temperature range
VIBRATION	-	Shall withstand 30G's of shock and vibration without causing any alterations of the disc module states
WRITING SPEED	-	As high as 120 character per second
FAILURE RATE	-	Proven average time between failure shall be over 200 million operations
REPAIR TIME	-	Average replacement time for repairing a failure shall be ten (10) minutes

TYPICAL VIEWING CHARACTERISTICS:

VIEWING ANGLE IN DEGREES	**DISTANCE IN FEET**
0	1,000
45	800
60	600
75	300
82.5	140

(H) CONTROLLER. The controller shall be housed in an aluminum cabinet with lockable door, sealed, weatherproofed and mounted to the rear of the sign board. The controller cabinet shall be mounted on the rear of the sign board to help eliminate vandalism. The controller cabinet contains an interior light for nighttime operation.

The controller shall be a micro-processor based unit with storage capacity of 200 preprogrammed messages and 4 diagnostic messages. A portable keyboard shall be provided to allow full control of the sign.

The controller shall contain a password feature to prevent unauthorized use.

The keyboard shall not be necessary for operation of the sign board after the call-up and display of a message or sequence of messages. The keyboard shall be able to be removed by the operator, which totally eliminates unauthorized use of the sign board.

The controller operating program shall be contained in EPROM and the preprogrammed and temporary messages are stored in non-volatile RAM.

From 1 to 200 preprogrammed messages shall be supplied to the District's requirements and specifications. The operator shall be able to store preprogrammed messages using the keyboard into any one of the 200 message locations.

The following is a listing of the commands which shall be available from the PDCMS keyboard:

1. Time
2. Day of the Week
3. Test
4. Select
5. Display
6. Ontime/offtime/Seqtime
7. Sequence
8. Clear

(I) MEASURE AND PAYMENT. The unit of measurement will be each. Payment for PORTABLE DISC CHANGEABLE MESSAGE SIGN will include furnishing and maintaining of each unit, including matrix message board, solid state controls, generator and trailer, and all accessories and incidentals required to provide an efficient operation.

616.23 REPAIR OF DAMAGED MAJOR TRAFFIC CONTROL DEVICES

(A) DESCRIPTION. Work consists of repairing, or replacing, if needed, major traffic control devices when damaged by vehicular traffic or vandalism that is deemed to be beyond the contractor's control. For the purposes of this section, major traffic control devices are described under:

616.09	**Sequential Arrow Boards**
616.18	**Truck Mounted Attenuator**
616.19	**Construction Zone Attenuator**
616.20	**Sand-Filled Impact Attenuator Module**
616.21	**Portable Variable Message Sign**
616.22	**Portable Disc Changeable Message Sign**

(B) MATERIALS. Replacement materials are as described elsewhere for the original items. The ordering of materials shall be in accordance with the manufacturer's or supplier's recommendations.

(C) CONSTRUCTION REQUIREMENTS. Construction requirements for use of each of the listed items are found in the section for that item and in the contract plans and specifications. Repair of listed devices shall be conducted in accordance with the manufacturer's recommendations. Regular maintenance (e.g. replacement of bulbs and lighting devices, etc.) and damage caused by the Contractor's own activities shall not be paid for under this item and the cost of said work shall be considered when preparing bid prices for the original item.

(D) MEASURE AND PAYMENT. The District will insert an estimated cost for this work in the "Bid Forms and Proposal". No action is required of the bidder. The actual cost paid under REPAIR OF DAMAGED MAJOR TRAFFIC CONTROL DEVICES for repair of each of the listed items will be the manufacturer's invoice cost plus 10% for all devices repaired or replaced as agreed to by the Engineer. In cases where the manufacturer or supplier is needed to perform the repair, the associated labor costs shall be included in this item with the concurrence of the Engineer. No payment will be made for the Contractor's labor involved in the repair of the device beyond the standard 10% markup indicated above.

When repair costs exceed the maximum dollar amount established by the District for this item, said amount will be increased to cover the estimated future costs of this work.